## Petroleum Systems of the Alaskan North Slope - A Numerical Journey from Source to Trap Transformation Ratio by C. Lampe<sup>1</sup>, K.E. Peters<sup>2</sup>, L.B. Magoon<sup>2</sup>, K.J. Bird<sup>2</sup>, and P.G. Lillis<sup>3</sup> <sup>3</sup>U.S. Geological Survey, P.O. Box 25046, MS 977, Denver, CO 80225 Geometry and Migration Composition and Phase-Behavior Model Statistics: REFERENCES Bird, K.J., 2001, Alaska: A twenty-first-Transformation Ratio for the Shublik □ □ □ □ □ 620 x 250 km century petroleum province, in M.W. source rock through time. Due to the Original Model Size: 1 623(x) x 256(y) with 26 layers Output Geometry Downey, J.C. Threet, and W.A. Morgan, prominent north south dip of the strata, **Simulated Size:** □ □ 155(x) x 82(y) x 38 (z) eds., Petroleum provinces of the twentythe source becomes mature in the south Number of Grid Cells: 476,012 whereas it stays immature in the north. first century: AAPG Memoir 74, p. 137-165. The prograding foresets have an Components: □ □ □ 9 (incl. Water) Molenaar, C.M, Bird, K.J., and Collett, T.S., additional effect on maturity as they shift red = gas **Timesteps:** $\square$ $\square$ $\square$ $\square$ 73 (Temperature/Pressure) 1986, Regional correlation sections across green = oil □ □ 1674 (Migration) the North Slope of Alaska: U.S. Geological Survey Miscellaneous Field Studies Map 55% Darcy Flow & Pressure □ Lillis, P.G., Lewan, M.D., Warden, A, Monk, □ □ □ □ □ □ □ □ 14% FlowPath□ S.M. and King, J.D., 1999, Identification \_ \_ \_ \_ \_ \_ \_ \_ \_ 6% Heat Close-up of two predicted accumulations cut by and characterization of oil types and their Alternation FlowPath/Darcy: 1155 wells "Colville Delta," "Kalubik Creek" and source rocks---Chapter OA (Oil Analyses), "West Sak River." The lower one is in the Sag Hardware: Five 1.26 GHz Pentium III processors with in ANWR Assessment Team, The Oil and River Sandstone, the upper one in the Kemik 2GB RAM each on a Linux Suse8.0 cluster Gas Resource Potential of the 1002 Area, Sandstone. Those two layers are the main Arctic National Wildlife Refuge, Alaska: reservoir horizons in this model. Composition **Expulsion Time** U.S. Geological Survey Open-File Report RESULTS and phases are shown for the upper 98-34, CD-ROM-ANWR, OA-1--OA-101. accumulation: it is mainly charged by Shublik Expulsion time (liquid in Ma) Petroleum is generated from about 125 Ma on. It originates petroleum, yet also contains hydrocarbons from Masterson, W., 2001, Petroleum filling for each source rock. in the deeply buried rocks of the southern part of the model all other source rocks. When flashed to surface \$ 1100 \$ 299941 m, 2143994 m, **+206006 ' ' ' ' -**100000 ' ' ' ' b ' ' ' ' (obobo' ' ' ' ' 20bobo' ' ' ' ' 5084928 history of central Alaska North Slope fields: and migrates primarily to the north. Up to about 110 Ma the pressure/temperature conditions phase Ph.D. Thesis, University of Texas at Dallas, W-E relief is relatively flat allowing an even distribution of separation becomes evident. Properties such petroleum. The onset of foreset deposition 120 Ma ago 222 p. as API gravity and gas-to-oil ratio (GOR) can induces W-E trending geometry changes. Subsidence in be given for each individual accumulation, for Wygrala, B.P., 1989, Integrated study of an the western part of the section drives the petroleum to the each reservoir layer or for the entire system. oil field in the southern Po basin, northern East and eventually out of the model (86 Ma). Pools remain Italy: Ph.D. Thesis, Berichte des in the highs of the Prudhoe Bay and Simpson Peninsula Forschungszentrums Juelich, 2313, 217 p. areas and keep being charged from the South. From 40 Ma Present-Day Migration Pattern 120 Ma (Hue-GRZ) years on, the subsidence/uplift pattern reverses, allowing 1299441 h, 2148944 h, 120600 ' ' ' 100000 ' ' ' ' 50046999 n subsidence in the East which drives the petroleum westwards towards the Prudhoe Bay area. Due to simultaneous uplift and pressure release in the West, the previously liquid accumulations degas to form a free gas Fully pvt-controlled n-component migration modeling of PetroMod allows the simulation of phase behavior (liquid versus vapor) in regard to all components during each time step. Phases and compositions can be predicted for each accumulation for both in-situ and surface conditions. Major migration pathways of liquid and vapor phases are mainly directed from South to North. Spilling and secondary migration pathways (caused by geometry changes induced by the foresets) run perpendicular to the major direction of migration.